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ABSTRACT

This syllabus gives a day by day descriptive account of the activities and subjects covered during a two-week in-service program on astronomy, physics, and Florida geology for teachers of grades one through nine. The program for the astronomy and physics was designed to accommodate four levels of instruction: Grades 1 and 2; Grades 3 and 4; Grades 5 and 6; and Grades 7, 8, and 9. A different track for each of these levels was presented so that each teacher could participate with a group most appropriate for his teaching level. Included are the objectives of the program and description of how the program was planned. This work was prepared under an ESEA Title III contract. (PP)

BESE TITLE III

EARTH-SPACE SCIENCE IN-SERVICE TRAINING SYLLABUS

Astronomy-Physics-Florida Geology & NASA Space Workshop

ESEA TITLE III PROJECT

EARTH-SPACE SCIENCE LEARNING CENTER

TRI-COUNTY AREA IN CENTRAL FLORIDA

Citrus-Lake-Sumter

EARTH-SPACE SCIENCE LEARNING CENTER

Public Law 89-10
ESEA TITLE III PROJECT

EARTH-SPACE SCIENCE

IN-SERVICE TRAINING

SYLLABUS

FOR TEACHERS IN GRADES ONE THROUGH NINE

ASTRONOMY - PHYSICS - FLORIDA GEOLOGY

NASA SPACE WORKSHOP

Proposal of

Lake County Board of Public Instruction
201 West Burleigh Boulevard, Tavares, Florida 32778
Telephone Area Code 904-343-3531

Jack Morgan, Superintendent

1968

EARTH-SPACE SCIENCE LEARNING CENTER

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ACKNOWLEDGEMENT

The Lake County Board of Public Instruction, the Members of the Board of Trustees, the Superintendent, and the Staff of the Earth-Space Science Learning Center wish to acknowledge their appreciation to the specialized consultants, Mr. Jack Maier, Dr. George Griffin, NASA Educational Program Staff, and Dr. Richard Ober for their inspiration and leadership in coordinating the plans for the in-service training program; and to the general and special consultants from the State Department of Education for their guidance and assistance; also to the members of the Steering Committee for their cooperation and dedication in working to meet the needs of each phase of this planning grant.

Astronomy and Physics by Mr. Jack Maier:
Professor of Astronomy and Physics
State University College at Oneonta
Oneonta, New York

Florida Geology by Dr. George Griffin:
Associate Professor of Geology
University of South Florida
Tampa, Florida

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Mr. Bob Binger, Science Consultant, SDE

Mr. Russell Freeman, Consultant for Exceptional Children, SDE

Mr. Jack King, Consultant General Instruction, SDE

The Steering Committee, composed of classroom teachers from the three counties, are listed below..

STEERING COMMITTEE (CLASSROOM TEACHERS)

Mr. Rudy Baxter	Jr. High Science	Sumter County
Mr. Lambert Bessa	Jr. High Science	Citrus County
Mrs. Clytie Brown	2nd Grade	Lake County
Mr. Robert Burnham	5th Grade	Lake County
Mr. Robert Cook	6th Grade	Lake County
Mrs. Ruth Delano	5th Grade	Lake County
Mrs. Mary Jane Erck	Jr. High Science	Lake County
Mrs. Margaret Evans	1st Grade	Lake County
Mrs. Fannie Gillespie	4th Grade	Lake County
Mr. Cook Gravelee	Jr. High Science	Lake County
Mrs. Katherine Halford	4th Grade	Lake County
Mrs. Anne Hamlin	1st Grade	Lake County
Mr. John Headlee	5 & 6 Grade Science	Citrus County
Mrs. Yvonne Heard	3rd Grade	Lake County
Mrs. Edna James	3rd Grade	Sumter County
Mr. Glenn Jones	Jr. High Science	Lake County
Mrs. Elizabeth Joyner	3rd Grade	Citrus County
Mrs. Jean McKeeby	1st Grade	Lake County
Mr. Marshall Morgan	6th Grade	Lake County
Mrs. Evie Pate	1 & 2 Grade	Sumter County
Mr. Drew Rambo	Jr. High Science	Lake County
Mrs. Jakie Roberts	5th Grade	Citrus County
Mrs. Mamie Rolle	2nd Grade	Lake County
Mrs. Faye Russell	Jr. High Science	Lake County
Mrs. Carol Tamsett	5th Grade	Lake County
Mrs. Will Lacey Shotts	Jr. High Science	Lake County
Mrs. Orleanna Sinclair	1st Grade	Sumter County
Mrs. Blanche Suttkus	5th Grade	Lake County
Mrs. Geraldine Williams	1st Grade	Sumter County
Mrs. Marilyn Williams	Special Education	Citrus County

Mr. David Treadway, Supervisor of Federal Projects, Lake County.

Mr. Carl d. Pettitt, Supervisor of Science and Mathematics, Lake County

Mr. Eudell Sutley, Supervisor of Language Arts, Lake County.

Earth-Space Science Learning Center Staff

Mr. Sam Commander, Project Director

Mr. Don McKeeby, Associate Director

INTRODUCTION

Demands for improvement of the quality of instruction in our schools over the past few years, coupled with the increased need for understanding of the learning process, have led to the provision of training programs for the staffs of the several schools within the tri-county area. Along with the rapid growth of knowledge within the fields of science and the need for a close look at course content and newer methods of instruction, a new challenge for the teachers to improve themselves has arisen -- a challenge that must be met by formal and informal periods of instruction to prepare them better for their daily instructional responsibilities.

Because many teachers find it difficult, because of distance, financial concerns, or unavailability of pertinent courses, to attend teacher training institutions on a part-time or evening basis, a need has arisen in the tri-county area to provide activities through which the teachers of science, grades one through nine, can strengthen themselves professionally by increasing their competencies and skills in the instruction within the several fields of science. This in-service education program has come into being to meet this need.

SCIENCE IN-SERVICE TRAINING PROGRAM
FOR CLASSROOM TEACHERS
GRADES ONE THROUGH NINE

One of the major goals in planning the overall program of the Earth-Space Science Learning Center was:

> To plan the development of an innovative In-Service Training Program in the field of earth-space science that would increase the knowledge of science teachers in the tri-county area.

The planning of the program involved many resource people from various areas of the educational field. The participants were from the tri-county area and other geographic areas throughout Florida and the United States. Included among them were:

1. Regular Classroom Teachers
2. Teachers of Exceptional Children
3. Elementary and Junior High Principals
4. Supervisors
5. Consultants from Universities, - in-state and out of state
6. Science Center Staff
7. Consultant from the State Department of Education

A steering committee of 30 classroom teachers was selected from all grade levels in elementary and junior high schools of the tri-county area by the supervisory staffs and principals. The Steering Committee and the resource people served as the nucleus in formulating the total program of the Earth-Space Science Learning Center. This group met with the Science Center Staff on the first Saturday of each month to plan the program of activities. Resource persons, selected for their

competence, gave assistance as the planning progressed.

In meeting with many of the consultants, members of the Steering Committee decided that a task oriented In-Service Training Program was of prime importance. To avoid a "sticky academic approach," it was felt that the teachers must:

1. Be actively involved in their programs at the Center
2. Have experiences they can and will take back to the classroom
3. Be provided with a new framework of teaching techniques, new bench marks or reference points, and modified behavioral patterns to carry back to their classrooms.

In planning the innovative In-Service Training Program for teachers in the tri-county area, these aspects were considered:

1. College level and/or credit
2. What time courses would be offered - day, month and hour
3. Where courses could be offered
4. Financing for the course
5. Remuneration for participants
6. Instructors to be used
7. Types of approach Instructor would use
8. Scope or length of course
9. Grouping of participants (grade level)
10. Subject areas to be taught
11. Selection of consultants to assist in developing and implementing the program.

12. A survey to find out the type of course desired by elementary and science teachers, grades one through nine.
13. Conferences with other subject-matter and geographical area personnel involved in In-Service Training for Teachers.
14. Research data on In-Service Training for Teachers which could lead to innovative approaches.
15. Evaluation of In-Service Training Studies.
16. Investigation of media which can be used in innovative science instruction.

The Steering Committee conducted a survey in the tri-county area to determine the subject-matter needs of all elementary and junior high teachers of science.

The survey form, compiled by the Steering Committee, covered the first eleven topics enumerated above. This survey form was sent to the Title III Grants Officer in Atlanta, Georgia, for approval. Upon receiving permission to conduct this survey, the Steering Committee members were assigned to certain schools in their counties where they would personally conduct the survey. The resulting information was returned to the Science Center where the staff tabulated the data.

The results of the survey enabled the Steering Committee to establish:

1. Location for In-Service Training Program
2. Grouping of participants
3. The scheduling of the course
4. Subject area to be taught

5. Length of the program

6. Selection of instructors for each subject area

The objective of the In-Service Training Program is:

> Provided the necessary time, place, and resources, one hundred and forty-four elementary and junior high school teachers, including teachers of exceptional children, will gain the technology, skills, and knowledge necessary to facilitate their teaching in designated areas of science at the appropriate grade levels. This objective will be acceptably achieved when data, collected according to procedures, standards, analyses, and interpretations to be determined by the participants, demonstrate the improvement of instruction in the designated area of science at the appropriate grade levels.

The In-Service Training Program will be conducted at the Earth-Space Science Learning Center, Howey-in-the-Hills, Florida, during the regular school year, 1968-69. The participants appropriately scheduled into four different sessions are shown below:

1. Teachers of grades one and two
2. Teachers of grades three and four
3. Teachers of grades five and six
4. Teachers of science in grades seven, eight, and nine
* 5. Teachers' of Exceptional Children

Each session will be two weeks long. The subject areas which will be taught for three days each are astronomy, physical science, and Florida geology will be taught for four days. Instructors who were selected to conduct each program have given assistance in setting up units of study in each subject-matter division and at grade level.

*These teachers will be placed in the section according to appropriate grade level.

The Steering Committee and classroom teachers recommended that the classroom teachers be furnished with substitutes for the two weeks of the In-Service Training Program. Holding the sessions during the regular school day would relieve each teacher of classroom responsibility and enable him to devote all his resources to this enrichment program. Since a classroom teacher is hesitant to leave his class to the care of someone else for that length of time, the substitutes will come into the classrooms to work for two days [prior to the teachers leaving to participate in the In-Service Training Program] in order to become acquainted with the children and oriented with lesson plans and classroom procedures.

The Steering Committee also recommended that the teachers of the first and second grades not participate in the program until after the first semester since their children need time to adjust to school situations.

The Science Center staff met with the superintendents, county supervisory staffs, elementary and junior high principals of the tri-county area to discuss several options available for In-Service Training. The consensus of these groups was the approval of the plan presented in the preceding paragraphs.

The subject-matter divisions which are included in this program of study, as previously stated, are astronomy, physics, and Florida geology.

The teaching consultants for the In-Service Training Program in science grades one through nine are:

Mr. Jack Maier--Astronomy and Physics
Professor of Astronomy and Physics
State University College at Oneonta
Oneonta, New York

Dr. George Griffin -- Geology

Associate Professor of Geology

University of South Florida

Tampa, Florida

Consultants which assisted in planning the In-Service Program were:

Mr. Bob Binger, Science Consultants

State Department of Education

Tallahassee, Florida

Mr. Russell Freeman, Consultant for Exceptional Children

State Department of Education

Tallahassee, Florida

Dr. Richard Ober, Assistant Professor College of Education

University of Florida

Gainesville, Florida

Mr. Jack King, Consultant General Instruction

State Department of Education

Tampa, Florida

The result of the consultation and planning done by the Steering Committee is a Program of In-Service Training which will help the participating teachers to become more innovative in, and knowledgeable of, science instruction. A description of the in-service training program follows.

IN-SERVICE TRAINING PROGRAM
IN ASTRONOMY FOR GRADES
ONE AND TWO

OBJECTIVES AND APPROACH: Plato said it: "There is no other beginning of learning than wonder. There is in every being's heart the love of wonder - the sweet amazement at the stars and the starlike things and thoughts." While wondering about where he came from and how he came to be where he is now, one can scarcely avoid possessing an amazing amount of curiosity concerning the things about him. Just as space itself appears almost boundless, questions relating to it similarly are limitless. Among these inquiries to be considered during our sessions together are:

Where does light come from?
Why is it light during the day
dark during the night?
Why are there temperature changes
from day to night?
What causes a shadow? What makes
them move during the day?
What makes our moon so bright?
What are stars? Why do they shine?
What are planets? Why do they shine?
Why can we see certain stars only during
certain times of the year?
Why do the planets seem to move through the stars?
Why does our moon seem to change its shape?
How does our earth compare with the other planets?
Why have we placed satellites of our own into space?

During our In-Service Training Program we shall explore the concepts suggested by these questions in addition to others as appropriate. Since astronomy is an observational science, we shall concern ourselves with techniques and instruments designed to help us obtain information about our earth and its position in, as well as motion through, space. Toward this purpose we shall carry out observation sessions in the planetarium and in the out-of-doors when weather permits. These will be blended with a series of laboratory, lecture-demonstrations, and discussion periods to afford a maximum opportunity for understanding the related concepts, for developing skills in the fabrication and subsequent utilization of various instruments, and for the analysis of data obtained by their use as well as from other sources.

To the extent that the design of the In-Service Training Program and time permit, it is the desire of the consultant to provide and pportunity

for the participant to:

1. Preview the material and activities to be covered in advance of each session, enabling him to prepare himself through consulting the references provided and thus gain a better insight into their direct application in his classroom.

2. Discuss any problems arising with the activities suggested after he has tried them out. The consultant will attempt to help the participants implement the subject-matter, as well as techniques, within the framework of his own classroom situation.

The design of the program will be suggested by the following sources:

1. Concepts in Science, Brandwein, Cooper, Blackwood, Hone for grades One and Two.

2. Science for Children, Grades K-3, New York State Education Department.

3. Astronomy: Charting the Universe, Elementary Science Project, University of Illinois, Urbana, Illinois.

4. Astronomy: The Universe in Motion, Elementary Science Project, University of Illinois, Urbana, Illinois.

(References to the source materials listed above will be numbered in the same order.)

FIRST DAY

PLANETARIUM PRESENTATION

SESSION ONE:

During this preliminary session we shall attempt to familiarize you with the evening sky for your particular geographic location.

We shall aid you with the identification of certain basic constellations, some of which are circumpolar, others of which are seasonal.

We shall also point out other celestial objects, when and where available, including planets and our moon.

We shall introduce to you a number of observations to be carried out in the planetarium, as well as during the night, following our presentation, skies permitting.

Emphasis will be placed upon the treatment of diurnal motions in the sky, the consequence of the earth's rotation.

Some questions to be taken up:

> In view of our latitude, which stars are circumpolar? Which are seasonal? Why?
>
> How are the apparent paths of the stars across the heavens effected by our latitude?
>
> Can we see the moon move through the stars? How might we plot its path from night to night?
>
> Which planets are "morning stars"? Which are "evening stars"? Why?

SESSION TWO: LABORATORY-DEMONSTRATION-DISCUSSION

We shall involve ourselves with observations and other activities to be carried on during the day and night to learn about:

> Differences on the earth when it is day and when it is night.
>
> Differences in the sky when it is day and night.
>
> The cause of day and night.
>
> The sizes and shapes of the moon, earth and sun.
>
> Our sun as a star.

Activities will be of two major types: Those to be teacher directed, and those to be carried out by the children.

They will be selected from:

(1) Grade One: Unit Six: Light and Dark, Sections 1 and 2

Grade Two: Unit Five: Darkness and Light

(2) The Solar System and Beyond: Units beginning on pages 27, 57 and 89

(3) Teacher's Guide 1: Chapters 1, 2 and 5

Teacher's Guide 2: Chapters 1, 2 and 3

SECOND DAY

PLANETARIUM PRESENTATION

SESSION ONE:

During this second session we shall first provide an opportunity to clear up any difficulties encountered in the observations suggested for last evening.

By advancing the planetarium through a number of "days" we shall describe a series of observations to be carried out which help develop the idea that the earth is revolving around the sun making it appear to describe a path through the background of stars known as the ecliptic.

We shall help to identify some of the zodiacal Constellation.

Emphasis will be placed upon the treatment of the apparent westward migration of the stars as a consequence of the earth's motion of revolution. We shall also consider the effect of this motion upon the positions of the planets.

Some questions to be taken up:

> How do the times at which certain constellations rise and set night after night compare with each other? Why?
>
> How does the clock face around the north star change through the seasons?
>
> What changes in the appearance of the planets with respect to the stars can we note from season to season with the naked eye? With the telescope?
>
> What changes in our moon can we note from night to night?

If available, a projection orrery will be employed during this session.

SESSION TWO: LABORATORY-DEMONSTRATION-DISCUSSION

We shall involve ourselves with observations and other activities to be carried out during the day and night to learn about:

> Differences on the earth both during the day and the night through the seasons.
>
> Differences in the sky during the day through the seasons.
>
> Differences in the sky during the night through the seasons.

Differences in the position of the planets in the skies from night to night and through the seasons.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade Two: Unit Nine: The Very Large, Section 1

(2) The Solar System and Beyond: Units beginning on pages 27, 57 and 89

(3) Teacher's Guide 1: Chapter Six

Teacher's Guide 2: Chapters Four and Five

THIRD DAY

PLANETARIUM

SESSION ONE:

During this final session we shall provide an opportunity to clear up any difficulties encountered in the observations suggested during the first two sessions.

We shall extend in depth the concepts introduced in session two, concerning the positions assumed by the sun on its ecliptic through the year and, in particular, its variation in the rate at which it seems to travel.

We deal with the displacement of the planets through the stars in terms of when we can anticipate viewing them through the year. (i.e., as morning stars, evening stars, all night long, or not at all)

We shall tie in the motions of the moon with our calendar and note the significance of its phases with respect to the beginning and end of our months. We shall note when it is best seen during the day; when best during the evening.

Some questions to be taken up:

> What does the rate at which the sun appears to travel through the stars tell us about the earth's motion upon its orbit?
>
> When during the year might you expect to see some of the planets, say Jupiter, as an evening star? As a morning star? All night long? Not at all?
>
> Noting in your calendar the date of the new moon in a certain month, can you predict when the next new moon will be? Why?

SESSION TWO: LABORATORY-DEMONSTRATION-DISCUSSION

We shall involve ourselves with observations and other activities to be carried out during the day and night to learn about:

> Locating the apparent path taken by the sun through the year.
>
> Locating the paths described by the planets through the stars as we watch them during the year.
>
> Differences in the appearance of the moon as it travels around the earth. (phases, apparent size)

Differences in the location of the moon with respect to the stars as it travels around the earth.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade One: Unit Six: Light and Dark, Section 3

Grade Two: Unit Nine: The Very Large, Sections 1 through 5

(2) The Solar System and Beyond: Units beginning on pages 27, 57 and 89

(3) Teacher's Guide 1: Chapters 4 and 5

Teacher's Guide 2: Chapters 5 and 6

IN-SERVICE TRAINING PROGRAM
IN ASTRONOMY FOR GRADES
THREE AND FOUR

OBJECTIVES AND APPROACH: Plato said it: "There is no other beginning of learning than wonder. There is in every being's heart the love of wonder - the sweet amazement at the stars and the starlike things and thoughts." While wondering about where he came from and how he came to be where he is now, one can scarcely avoid possessing an amazing amount of curiosity concerning the things about him. Just as space itself appears almost boundless, questions relating to it similarly are limitless. Among those inquiries to be considered during our sessions together are:

Where does the earth obtain its heat and light?
How do the other planets compare with the earth in the amount of heat and light which they receive? Why?
What would a day be like on the other planets? A year? Why?
If we took a trip to the other planets what would we find on them?
How much would we weigh on the other planets? Why?
What would it be like to live on the moon?
Why does it have phases?
What are these mysterious comets?
How are meteors related to them?
How does a telescope help us to get some of the answers to our questions about our neighbors in space?

During our In-Service Training Program we shall explore the concepts suggested by these questions in addition to others as appropriate. Since astronomy is an observational science we shall concern ourselves with techniques and instruments designed to help us obtain information about our earth and its position in, as well as motion through, space. Toward this purpose we shall carry out observation sessions in the planetarium and in the out-of-doors when weather permits. These will be blended with a series of laboratory, lecture-demonstrations, and discussion periods to afford a maximum opportunity for understanding the related concepts, for developing skills in the fabrication and subsequent utilization of various instruments, and for the analysis of data obtained by their use as well as from other sources.

To the extent that the design of the In-Service Training Program and time permit, it is the desire of the consultant to provide an opportunity for the participant to:

1. Preview the material and activities to be covered in advance of each session, enabling him to prepare himself through consulting the references provided and thus gain a better insight into their direct application in his classroom.

2. Discuss any problems arising with the activities suggested after he has tried them out. The consultant will attempt to help the participants implement the subject-matter, as well as techniques, within the framework of his own classroom situation.

The design of the program will be suggested by the following sources:

1. Concepts in Science, Brandwein, Cooper, Blackwood, Hone for Grades Three and Four.

2. Science for Children, Grades K-3, New York State Education Department.

3. Science for Children, Grades 4-6. New York State Education Department.

4. Astronomy: Gravitation, Elementary Science Project, University of Illinois, Urbana, Illinois.

5. Astronomy: The Universe in Motion, Elementary Science Project, University of Illinois, Urbana, Illinois.

(References to the source materials listed above will be numbered in the same order.)

FIRST DAY

PLANETARIUM

SESSION ONE:

During this preliminary session we shall attempt to familiarize you with the evening sky for your particular geographic location.

We shall aid you with the identification of certain basic constellations, some of which are circumpolar, other of which are seasonal.

We shall point out other celestial objects, when and where available, including planets and our moon.

We shall introduce you to a number of observations to be carried out in the planetarium, as well as during the night following our presentation, skies permitting.

Emphasis will be placed upon developing a frame of reference with respect to the stars in which the rotation of the earth takes place. The significance of the location of the end of the earth's axis as approximated by the star Polaris will be pointed out. Some stars which would pass directly over head for persons on the earth's equator will similarly be identified.

Attention will then be focused upon the location of the plane within which the earth revolves (the apparent path of the sun, the ecliptic) as indicated by stars and constellations located near it.

To be noted will be the fact that the planets identified above are also located near this plane.

Some questions to be taken up:

> Through which of the constellations does the sun appear to pass through the year?
>
> How do these constellations also help us to locate the planets in the skies?
>
> Can we determine from observation exactly how the earth's axis is tilted with respect to the plane within which it rotates? (i.e., the plane of its equator).
>
> Is this tilt also related to the specific constellations which are visible during certain seasons of the year? How?

Does the position of the earth on its orbit influence how we see the planets? (i.e., when during the day and where with respect to the horizon?)

SESSION TWO: LABORATORY-DEMONSTRATION-DISCUSSION

We shall involve ourselves with observations and other activities to be carried out during the day and night to learn about:

Some ways in which solar energy can be harnessed.

How the motions of the planets compare with each other in terms of their distances from the earth.

How observations of their motions are effected by the motions of the earth-based observatory.

How we have studied the surfaces of the planets.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade Three: Unit One: Energy from the Sun, Section 1

Unit Three: Beyond the Earth, Sections 1-3

(2) The Solar System and Beyond: Unit beginning on page 124

(5) Chapter 4

SECOND DAY

PLANETARIUM

SESSION ONE:

During this second session we shall provide an opportunity to clear up any difficulties encountered in the observations suggested for last evening.

By advancing the planetarium through a number of "days" we shall note how the sun appears to travel through the stars as a result of the earth's revolution. In this respect we shall note that it passes through one of the Zodiacal constellations per month, thus giving an indication of the rate at which the earth travels on its orbit. Attention will be directed to the location of the north pole of the earth's orbit (north ecliptic pole) and its distance from the star Polaris which identifies the end of the earth's axis.

By use of the projection of the inferior planets we shall compare the rates at which they move through the stars with the rate at which the earth seems to move.

By use of the superior planets in projection we shall compare the rates at which they move through the stars with the rate at which the earth seems to move.

From the two demonstrations above we shall develop, in only a very simple way, how we have been able to determine the periods of the other planets in our solar system.

To be tied in with these periods will be the relationship which exists between these periods and their distances from the sun.

Some questions to be taken up:

How long does the sun "stay in a given constellation"?

How long do each of the planets stay in a given constellation?

How does the motion of the earth influence each of the above?

How do the periods of a planet compare with the time each takes to revolve around the sun?

SESSION TWO: LABORATORY-DEMONSTRATION-DISCUSSION

We shall involve ourselves with observations and other activities to be carried out during the day and night to learn about:

How we have observed and thus analyzed the motion of the moon with respect to the earth as viewed against the background of star.

How its orbit is oriented with respect to the earth's orbit and the significance of the orientation to the occurence of eclipses.

How we have studied the surface of the moon and information we have gleaned from this study.

What it would be like to attempt to live on the moon and the basis of what we know about the moon in this regard.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade Three: Unit Three: Beyond the Earth, Section 4

(2) The Solar System and Beyond: Grades K-3, Unit beginning on page 124

(3) The Solar System and Beyond: Grades 4-6, Unit beginning on page 44

(4) Chapter 1

(5) Chapter 4 and 5

THIRD DAY

PLANETARIUM

SESSION ONE:

During this session we shall review the concepts covered in the past two days, offering an opportunity to rectify any difficulties encountered in the observations suggested.

With the use of a projection orrery, if available, we shall set about showing the relationships between the geocentric observations which we have considered with the actual heliocentric motions taking place. (i.e., where is the earth with respect to the sun such that it places the sun in a given constellation? How is the motion of a planet, as well as the earth, responsible for placing a planet in a given constellation?)

We shall move the moon through a month of its phases noting how it, too, passes through the constellations. We shall identify its path with these constellations and compare it with the apparent path of the sun (the ecliptic).

Attention will be given to the period of the revolution of the moon with respect to the stars and then with respect to the sun. The phenomena of lunar and solar eclipses will be investigated.

Some questions to be taken up:

The set of questions suggested at the end of the second day session in the planetarium will be reviewed in light of the use of the projection orrery and the relationship between geocentric observations and the corresponding heliocentric motions attributed to the planets.

> How is the path of our moon around the earth oriented with respect to the earth's orbit in space?
>
> During what phases can an eclipse take place?
>
> Why do we not have at least two eclipses every month?
>
> How many eclipses during a year do we have?

SESSION TWO: LABORATORY-DEMONSTRATION-DISCUSSION

We shall involve ourselves with observations and other activities to be carried out during the day and night to learn about:

> How we have discovered comets.

How we have determined what they are made of. What information we have gleaned about them in this respect.

In view of what we have learned about them where do we believe they came from.

How their motion in our solar system is most unique when compared with their fellow wonderers in this family.

What we have discovered about "Shooting Stars" and how they seem to be related to the mysterious comets.

How can we predict some, but not all, of these strange visitors from outer space.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade Four: Unit Eight: The Voyage of Haley's Comet, all sections.

(3) The Solar System and Beyond: Unit beginning on page 44.

IN-SERVICE TRAINING PROGRAM
IN ASTRONOMY FOR GRADES
FIVE AND SIX

OBJECTIVES AND APPROACH: Plato said it: "There is no other beginning of learning than wonder. There is in every being's heart the love of wonder - the sweet amazement at the stars and the starlike things and thoughts." While wondering about where he came from and how he came to be where he is now, one can scarcely avoid possessing an amazing amount of curiosity concerning the things about him. Just as space itself appears almost boundless, questions relating to it similarly are limitless. Among these inquiries to be considered during our sessions together are:

Where does weight come from?
How much would you weigh on the moon?
On other planets?
Why?
Why do the planets stay in their orbits around the sun?
What holds the moon to the earth?
Do you have inertia?
How can we weigh the planets? The stars?
What does the telescope do to light in order to help us study bodies a long way off?
How can we fingerprint a star?
What is a spectroscope?
What does it do to light?
What is the life cycle of a star?
How do we study Stars?
How can we determine the distance to stars?
Their speed in space?
Where did our solar system come from? Our galaxy?

During our In-Service Training Program we shall explore the concepts suggested by these questions in addition to others as appropriate. Since astronomy is an observational science, we shall concern ourselves with techniques and instruments designed to help us obtain information about our earth and its position in, as well as motion through, space. Toward this purpose we shall carry out observation sessions in the planetarium and in the out-of-doors when weather permits. These will be blended with a series of laboratory, lecture-demonstration, and discussion periods to afford a maximum opportunity for understanding the related concepts, for developing skills in the fabrication and subsequent utilization of various instruments, and for the analysis of data obtained by their use as well as from other sources.

To the extent that the design of the In-Service Training Program and time permit, it is the desire of the consultant to provide an opportunity for the participant to:

1. Preview the material and activities to be covered in advance of each session, enabling him to prepare himself through consulting the references provided and thus gain a better insight into their direct application in his classroom.

2. Discuss any problem arising with the activities suggested after he has tried them out. The consultant will attempt to help the participant implement the subject-matter as well as techniques within the framework of his own classroom situation.

The design of the program will be suggested by the following sources:

1. Concepts in Science, Brandwein, Cooper, Blackwood, Hone for grades five and six.

2. Science For Children, Grades 4-6, New York State Education Department.

3. Astronomy: Gravitation, Elementary Science Project, University of Illinois, Urbana, Illinois.

4. Astronomy: The Message of Starlight, Elementary Science Project, University of Illinois, Urbana, Illinois.

(References to the source materials listed above will be numbered in the same order.)

FIRST DAY

PLANETARIUM PRESENTATION

SESSION ONE:

During this preliminary session we shall attempt to familiarize you with the evening sky for your particular geographic location.

We shall aid you with the identification of certain basic constellations which are particularly appropriate for establishing the position of the earth in the heavens with respect to the plane of its equator. The apparent motions of the stars parallel to this plane; then afford an excellent basis for analysis of the earth's rotation.

We shall also point out the stars in the vicinity of the North Celestial Pole (near Polaris).

We shall discuss what is actually meant by constellations and indicate in particular that the stars making up each group are not equally distant from us as was historically believed.

We shall discuss each star as an entity in itself in terms of its size, mass, stage in its life cycle and finally motions in the stellar universe.

Some questions to be taken up:

> What information concerning the rotation of the earth can be learned by observing the stars in the vicinity of the plane of the celestial equator?
>
> In the vicinity of the north celestial pole?
>
> What information can be obtained from the beam of light sent to us from a star through so many miles in space?
>
> Do the stars actually move themselves? How have we studied these motions from so far away?

SESSION TWO: LABORATORY-DEMONSTRATION-DISCUSSION

We shall involve ourselves with observations and other activities to be carried out during the day and night to learn about:

> How an object (or body) moves in terms of the forces operating upon it.
>
> The meaning of inertia.

The study of weight as a force and its relation to mass.

The force responsible for holding us on the earth is the same kind that holds the planets on their orbits.

How gravities of various celestial bodies, the planets, their moons, the sun, are related to their masses.

The difference between motion in a straight line and in a curved path in terms of the forces responsible.

The meaning of acceleration.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade Five: Unit Three: The Earth in Orbit, Section 1, 2, 3.

(2) The Solar System and Beyond, Unit beginning on page 56.

(3) Chapters 1,2,3,4, and 5.

SECOND DAY

PLANETARIUM PRESENTATION

SESSION ONE:

During this session we shall review the ideas put forth in our first program. Should any difficulty be experienced with the observations proposed, we shall attempt to remove them.

The remainder of the session will be devoted to establishing the position of the earth in the heavens with respect to the plane within which it revolves, the ecliptic. The apparent path of the sun through the zodiacal constellations will be demonstrated and its significance with regard to the seasons explored.

Planetary motions on the part of the other planets in our solar system with respect to these constellations (and the earth's orbit) will also be demonstrated and their significance developed.

As in the first presentation we shall concentrate finally upon the characteristics and motions of the stars as entities in themselves.

Some questions to be taken up:

Does the sun pass through the constellations from season to season in a uniform way?

What significance does this have in regard to the motion of the earth on its orbit?

Do the planets all travel through the constellations at the same rate? At uniform rates?

To what extent does the motion of the earth contribute to these motions exhibited by the planets?

How can we determine this?

Where is the pole at the end of the axis about which the earth revolves?

What stars help to locate it?

What are some of the unusual characteristics of the stars contained in the constellations which we have just pointed out?

SESSION TWO: LABORATORY-DEMONSTRATION-DISCUSSION

We shall involve ourselves with observations and other activities to be carried out during the day and night to learn about:

Forces in space: By the earth upon an astronaut

By the earth upon our moon

By the sun upon the earth and moon as well as other planets

Between the stars (i.e., double stars)

Motions of stars through space and how effected by forces in the galaxy. The speed of stars (including our sun) in our galaxy.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade Five: Unit Three, The Earth in Orbit, Sections 4-7

Grade Six: Unit Nine, Stars and Starlight, Section 5

(2) The Solar System and Beyond, Unit beginning on page 86

(3) Chapters 7, 8, 9 and 10

THIRD DAY

PLANETARIUM PRESENTATION

SESSION ONE:

A brief review with an opportunity for questions regarding the observation program suggested up to now will be followed by an exploration of the stars and associated constellations which enable us to picture the position of the earth and its sun with respect to the galaxy (Our Milky Way).

The constellations visible during each season will be identified and their significance with regard to the section of the galaxy which we can explore during that season indicated and discussed.

How we have gained information, regarding the motion of the sun (and earth with it) within our galaxy, from observing the stars and particularly their motions as observed from the earth and discussed.

How we have explored the shape and size and the motions of our galaxy as a whole by observing the stars will also be discussed.

Some questions to be taken up:

Are there really stars out beyond the end of the beams of light which we observe?

How can we tell the difference between the actual motion of a star and the motion ascribed to it because of some motion on the part of our observatory located upon a moving earth?

How do the motions of the stars give a basis of determining the motion of our sun (with the earth) through the galaxy?

How have we "measured" our galaxy?

How have we come up with a picture of its shape?

How have we explored its motion about its own axis?

Its motion through space?

SESSION TWO: LABORATORY-DEMONSTRATION-DISCUSSION

We shall involve ourselves with observations and other activities to be carried out during the day and night to learn about:

The instruments employed in the study of light emitted by the stars.

How we study the light from the stars to determine:

The temperature of a star

The size of a star

The motion of a star

How we have studied the lifecycle of a star.

How we have studied the size and shape of our galaxy and the position of the sun in it.

How we have come to some tentative conclusion regarding the origin of our solar system and of our universe.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade Six: Unit Nine, Sections all

(2) The Solar System and Beyond, Unit beginning on page 143

(4) Chapters 2, 3, 4, 5 and 8

IN-SERVICE TRAINING PROGRAM
IN ASTRONOMY FOR GRADES
SEVEN, EIGHT, NINE

OBJECTIVES AND APPROACH: Plato said it. "There is no other beginning than wonder. There is in every being's heart the love of wonder - the sweet amazement at the stars and the starlike things and thoughts." While wondering about where he came from and how he came to be where he is now, one can scarcely avoid possessing an amazing amount of curiosity concerning things about him. Just as space itself appears almost boundless, questions relating to it similarly are limitless. Among these inquiries to be considered during our sessions together are:

What information about the motions of the earth can we glean from observations made of the apparent motions of the stars?
How can one determine the time and his geographic location by sighting upon the stars?
How have we determined that the earth "wobbles" (precesses on its axis and what are some of the consequences of this motion?)
How have we studied the motions and the surface features of our natural satellite and what have we found out about them?
How have we determined the size, mass, and density of the earth, our moon, our sun and the planets?
How have we investigated the motions and physical features of our neighbors in the solar system and what have we found out about them?
How have we studied the motions and physical characteristics of the stars and what have we found out about them?
How is a star born?
How have we studied our galaxy and the universe beyond, and what have we found out about the place of the sun in this vastness of space?
What theories have we developed concerning the origin of the universe and upon what information are they based?

During our In-Service Training Program we shall explore the concepts suggested by these questions in addition to others, as appropriate. Since astronomy is an observational science, we shall concern ourselves with techniques and instruments designed to help us obtain information about the earth and its position in, as well as motion through, space. Toward this purpose we shall carry out observation sessions in the planetarium and in the out-of-doors when weather permits. These will be blended with a series of laboratory, lecture-demonstrations, and discussion periods to afford a maximum opportunity for understanding the related concepts, for developing skills in the fabrication and subsequent utilization of various instruments, and for the analysis of data obtained by their use as well as from other sources.

To the extent that the design of the In-Service Training Program and time permit, it is the desire of the consultant to provide for the participant to:

1. Preview the material and activities to be covered in advance of each session, enabling him to prepare himself through consulting the references provided and thus gain a better insight into their direct application in his classroom.

2. Discuss any problems arising with the activities suggested after he has tried them out. The consultant will attempt to help the participant implement the subject-matter as well as techniques within the framework of his own classroom situation.

The design of the program will be suggested by the following sources:

Investigating the Earth, Earth Science Curriculum Project, in particular the Teacher's Guides Part I and II.

(References to the source materials listed above will be numbered in the same order.)

FIRST DAY

PLANETARIUM PRESENTATION

During this preliminary session we shall attempt to familiarize you with the evening sky for your particular geographic location.

We shall aid you with the identification of certain basic constellations, some of which are circumpolar, others of which are seasonal.

We shall examine in detail the diurnal motion of the stars as a function of the rotation of the earth. In particular a series of observations to be carried out from night to night to observe as an investigation of the basis upon which we tell time by the stars. The significance of the sidereal day will be demonstrated in terms of its role in aiding us to determine our geographic longitude.

The determination of time by the sun will be demonstrated. This technique, in connection with that involved in determining time by the stars, will be employed in the investigation of the revolution of the earth and its role in time-telling.

The coordinate systems of horizon and of the equator will be introduced and their applications demonstrated.

The effect of precession of the earth's axis will be discussed and demonstrated should the instrument permit it.

Some questions to be taken up:

In what way is the diurnal motion of the stars a function of the latitude of the observer?

Which constellations will be circumpolar?

Which seasonal?

How can the time by the sun be determined even at night?

What factors effect the length of the apparent solar day?

At what time of the year do we experience the longest days of the year?

The shortest days?

What effect does the precession of the earth have upon our seasons?

When we see certain constellations?

The location of the north celestial pole?

What observations of celestial objects lead to the determination of the size of the earth?

SESSION TWO: LABORATORY-DEMONSTRATION-DISCUSSION

We shall involve ourselves with observations and other activities to be carried out during the day and night to learn about:

How the size and shape of the earth has been determined?

How we locate places on the earth?

How the stars provide a frame of reference for earth motions?

How we know the earth rotates?

That the earth revolves?

How we investigate the sun's apparent path through the stars?

Why the earth has seasons?

What is responsible for changes associated with each of the seasons?

How we tell what time it is?

What day it is?

What month it is?

How we might tell time on the moon?

Activities will be of two major types; Those to be teacher directed and those to be carried out by the pupils.

They will be selected from:

Investigating the Earth, Teacher's Guide Part I

Unit I, The Dynamic Earth,
Unit 3, Earth Measurement, Page 92
Unit 4, Earth Motions, Page 120

SECOND DAY

PLANETARIUM PRESENTATION

SESSION ONE:

During this session we shall allow time to clear up any difficulties encountered in the observation program outlined in our first session and carried out (weather permitting) the night before.

We shall point out the positions in the night sky of our moon and of the planets when and where visible.

We shall investigate the orbital motion of the moon in terms of its phases and times of rising and setting with respect to the sun from night to night.

The circumstances of an eclipse of the moon and of the sun will be demonstrated and developed in greater depth during our laboratory period.

Techniques of plotting the path of the moon and of the planets will be illustrated and again extended during an ensuing laboratory period.

Use of a projection orrery will enable us to compare our geocentric observations with the actual heliocentric motions in our solar system. The positions and phases associated with these positions will be discussed and demonstrated where possible. Emphasis will be placed on the basis upon which planetary positions in the evening or morning sky can be predicted.

Some questions to be taken up:

How are the phases and times of rising and setting of our moon influenced by its position upon its orbit?

How can these be predicted?

How is our calendar based upon the month of phases?

Why is it so erratic?

Why does the moon not reach the same apogee and perigee distances from month to month?

During what time of the year could we explore the full moon the best?

What is the typical motion displayed by the planets through the stars?

In what ways is this influenced by the actual motion of the planet and by the motion of our earth on its orbits?

What is meant by retrograde motion and what causes a planet to exhibit this type of motion?

How do the present explanation of planetary motion compare with those in the early history of astronomy?

SESSION TWO: LABORATORY-DEMONSTRATION-DISCUSSION

We shall involve ourselves with observations and other activities to be carried out during the day and night to learn about:

How we have studied and what we have found out about the surface of the moon. We shall study its topography through the eyes of our terrestrial telescopes and our lunar probes.

The motions of the moon as seen from the earth with respect to the sun and with respect to the background of stars.

The motions of the earth-moon system about the sun.

Theories regarding the origin of the moon.

The motions, positions and corresponding phases of the planets as observed from the earth with respect to the sun.

Various models proposed for our solar system through the years.

The motions of the asteroids, meteoroids and comets.

The physical characteristics of the various members of our solar system with implications regarding the possibility of life upon any of them and basis upon which we have theorized about their origin.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the pupils:

They will be selected from:

Investigating the Earth, Teacher's Guide Part II
Unit IV, Earth's Environment in Space, 22
The Moon: A Natural Satellite, Page 604
23, The Solar System, Page 626

THIRD DAY

PLANETARIUM PRESENTATION

SESSION ONE:

Time will be allocated for review and correction of any difficulties in previous work.

Identification and discussion of various types of stars will be the concern of this session.

Classification of stars with respect to spectra, size, mass and distance will be carried out.

A discussion of their motions, radial, tangential, proper, and space will be provided.

The place of the sun in our galaxy with a description of the location of the Milky Way with regard to constellations marking it will be provided. The sections of the galaxy particularly visible during certain seasons will be shown and discussed.

Questions to be taken up:

Upon what types of observations are our classifications of the stars based?

What is the life history of a star?

Upon what observations has the determination of the position of the sun in our galaxy been based?

The motion of the sun in our galaxy?

What are some examples of binary stars?

Of what value is a study of these stars?

What are some examples of variable stars?

Of what value is a study of these stars?

What studies have been carried out regarding the possibility of life in our galaxy outside of our solar system?

What type of stars have we investigated?

Why?

SESSION TWO: LABORATORY-DEMONSTRATION-DISCUSSION

We shall involve ourselves with observations and other activities to be carried out during the day and night to learn about:

How we measure the radiation and luminosity of the stars?

How we stuiy the motions, distances, and masses of stars?

How we determine the chemical makeup of stars?

A comparison of stars with our sun.

How we determine the sizes of stars?

How we study the evolution and life histories of the stars?

The significance of the H-R diagram.

How we study the shape and motion of our galaxy and have determined the position of the sun in it?

How we have investigated neighboring galaxies in space?

How do they compare with our own?

How we have determined motions of other galaxies in space?

The significance of the "red shift" in studying the Universe beyond.

The concept of the "Expanding Universe."

Activities will be of two major types: Those to be teacher directed and those to be carried out by the pupils:

They will be selected from:
Investigating the Earth, Teacher's Guide Part II

Unit IV, Earth's Environment in space, 24, Stars as Other Suns Page 648
25, Stellar Evolution and Galaxies, page 670
26, The Universe and its Origin, Page 686

IN-SERVICE TRAINING PROGRAM
IN PHYSICS FOR GRADES
ONE AND TWO

OBJECTIVES AND APPROACH: Edmund Spenser in "The Tears of the Muses' says:

> Through knowledge we behold the world's creation,
> How in his cradle first he fostered was;
> And judge of Nature's cunning operation,
> How things she formed of a formless mass . . .

A child's curiosity concerning the things about him seem insatiable. Unlimited are the questions which he raises about things which he can see. Quite often difficult, however, are the answers which inevitably border on the abstract.

> Things which are seen were not made of things
> which do appear. Hebrews, XI:3

It will be the attempt of this in-service training program to meld the concrete with the abstract: to establish relationships between things which we can see and those which we cannot see.

Physics is not merely a body of subject-matter nor is it a collection of mathematical puzzles. It is a science of inquiry. During our sessions together we shall consider such inquiries as:

> What is energy? Where does energy come from?
> Why is it so important in our daily lives?
> What causes us to move? How can we control
> our motion?
> How can motion under control accomplish work?
> How do we use this mysterious force called
> "magnetism"?
> How can we use and control magnetic forces?
> What do we mean by "hot" and "cold"?
> How can we change the appearance of a substance
> by making it "hot" or "cold"?
> How do we measure "hot" and "cold"?
> What happens "inside" of a substance when it is
> heated or cooled? How can we tell by looking at
> the substance from the outside?
> What is sound? How can we make it, use it, and con-
> trol it?
> How does sound travel?
> Where does light come from? How do we use and control it?

During our in-service training program we shall explore the concepts suggested by these questions in addition to others as appropriate. Since Physics is an experimental science we shall concern ourselves with the methods and materials designed to help us obtain information about our physical environment. Toward this purpose we shall carry out a series of sessions in the laboratory which will be blended with periods occupied by lecture-demonstrations and discussions to afford a maximum opportunity for understanding the related concepts, for developing skills in the fabrication and subsequent utilization of various materials, and for the analysis of data obtained by their use as well as from other sources.

To the extent that the design of the in-service training program and time permit, it is the desire of the consultant to provide an opportunity for the participant to:

1. Preview the material and activities to be covered in advance of each session, enabling him to prepare himself through consulting the references provided and thus gain a better insight into their direct application in his classroom.

2. Discuss any problems arising with the activities suggested after he has tried them out. The consultant will attempt to help the participants implement the subject-matter as well as techniques within the framework of his own classroom situation.

The design of the program will be suggested by the following sources:

1. Concepts in Science, Grades 1-2, Brandwein, Cooper, Blackwood and Hone.

2. Science For Children, Grades K-3, New York State Education Department.

(References to the source materials listed above will be numbered in the same order.)

FIRST DAY

SESSION ONE: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

ENERGY AND MOTION

We shall begin to develop the concept of energy and its role in causing motion. We shall define energy in terms of its sources and types. We shall examine its role in accomplishing work.

We shall further develop the concept of force as a part of work, as well as its role in making things move faster.

Important to recognize here will be the difference between a balanced and an unbalanced force.

(1) Grade 1: Units One, Two and Three.

SESSION TWO: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

FORCES

Continuing with the agenda above we shall further develop the concept of force in terms of useful or resistive to accomplishing work. We shall explore the two major forces of gravity and of magnetism in terms of their sources and effects upon doing work. Similarly the force of friction will be investigated as an aid and as a detriment in doing work.

Activities will be of two major types: Those to be Teacher directed and those to be carried out by the children. They will be selected from:

(1) Grade 1: Units Two and Three

(2) Unit on Magnetism pages 129-133

SECOND DAY

SESSION ONE: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

MATTER AND HEAT

We shall examine examples of the three states in which matter can exist and relate to these the role of heat played in determining which state a particular substance is found in. We shall also note that temperature, although not synonymous with, is very closely related to heat as well as to the state in which a substance is found.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 1: Unit Four
(2) Unit on Matter pages 94-97

SESSION TWO: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

MATTER AND HEAT

The relationship between heat and temperature will be explored more closely in terms of another reaction of matter to heat energy, - that of expansion. The results of adding heat on what happens to a substance in terms of its size and temperature will be dealt with. Similarly, what happens when heat is lost will be explored.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 2: Unit Two
(2) Unit on Heat and Light pages 61-64

THIRD DAY

SESSION ONE: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

Sound

We shall investigate how sounds are made and how they travel. Types of sounds in terms of how they are caused as well as how they are received and identified by the human ear will be dealt with.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 2: Unit Four
(2) Unit on Sound, pages 31-34

SESSION TWO: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

LIGHT

We shall compare light with sound in terms of how it travels and how we perceive it. We shall consider various sources of light and the means by which this light travels from place to place. What can happen to light as it hits a surface will be explored in terms of reflection, transmission, and absorption. To be introduced briefly will be the concept of color, its source, and factors responsible for the color of an object.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 2: Unit Five
(2) Unit on Heat and Light, pages 61-64

IN-SERVICE TRAINING PROGRAM
IN PHYSICS FOR GRADES
THREE AND FOUR

OBJECTIVES AND APPROACH: Edmund Spenser in "The Tears of the Muses" says:

> Through knowledge we behold the world's creation,
> How in his cradle first he fostered was;
> And judge of Nature's cunning operation,
> How things she formed of a formless mass . . .

A child's curiosity concerning the things about him seems insatiable. Unlimited are the questions which he raises about things which he can see. Quite often difficult, however, are the answers which inevitably border on the abstract.

> Things which are seen were not made of things which do appear.
> Hebrews, XI:3

It will be the attempt of this In-Service Training Program to meld the concrete with the abstract; to establish relationships between things which we can see and those which we cannot see.

Physics is not merely a body of subject-matter nor is it a collection of mathematical puzzles. It is a science of inquiry. During our sessions together we shall consider such inquiries as:

> Do things standing still possess energy?
> Do moving objects possess energy?
> How can one form of energy (potential) be converted into another form of energy (kinetic)?
> What is necessary in order to accomplish work?
> What forms of energy do we know of?
> Are all of these forms directly useful in accomplishing Work?
> Can we convert one form of energy into another?
> What form of energy allows a substance to exist in more than one state (gas, liquid, or solid)?
> Can a substance either gain or lose energy?
> What changes take place in the substance under these two conditions?
> How are heat and temperature related?
> What types of substances can make sound?
> In what way may the pitch of a sound be changed?
> How does sound travel?
> How fast does sound travel?
> Can it travel in a vacuum?

What makes a substance visible?
What can happen to light when it hits a substance?
Why?
How does light travel through various substances
and how do they effect its travel?

During our In-Service Training Program we shall explore the concepts suggested by these questions in addition to others as appropriate. Since Physics is an experimental science we shall concern ourselves with the methods and materials designed to help us obtain information about our physical environment. Toward this purpose we shall carry out a series of sessions in the laboratory which will be blended with periods occupied by lecture-demonstrations and discussions to afford a maximum opportunity for understanding the related concepts, for developing skills in the fabrication and subsequent utilization of various materials, and for the analysis of data obtained by their use as well as from other sources.

To the extent that the design of the In-Service Training Program and time permit, it is the desire of the consultant to provide an opportunity for the participant to:

1. Preview the material and activities to be covered in advance of each session, enabling him to prepare himself through consulting the references provided and thus gain a better insight into their direct application in his classroom.

2. Discuss any problems arising with the activities suggested after he has tried them out. The consultant will attempt to help the participants implement the subject-matter as well as techniques within the framework of his own classroom situation.

The design of the program will be suggested by the following:

1. Concepts in Science, Brandwein, Cooper, Blackwood, Hone, for Grades Three and Four.

2. Science for Children, Grades K-3 and 4-6, New York State Education Department.

(References to the source materials listed above will be numbered in the same order.)

FIRST DAY

SESSION ONE: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

ENERGY: POTENTIAL and KINETIC

The relationship between energy and work will be reviewed. To be analyzed will be the capacity of an object to do work when stationary (potential) and while moving (kinetic). The equality of potential to kinetic energy and the circumstances responsible for this will be explored. The uselessness of certain forms of energy until they are converted to another form will be dealt with.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 3: Unit Two
(2) Unit on Heat and Energy, pages 51-56 (For Grades 4-6)

SESSION TWO: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

ENERGY: ITS VARIOUS FORMS

Continuing our study in session one above we shall explore the various forms of energy and, in particular, the methods by which certain forms can be converted into other forms. The specific uses to which certain forms can be put will be reviewed in terms of the characteristics of each of these forms which make them useful. Such forms as mechanical, heat, chemical, and electrical will be considered.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 3: Unit Two
(2) Unit on Heat and Energy - pages 51-56 (For Grades 4-6)

SECOND DAY

SESSION ONE: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

ELECTROMAGNETISM

We shall explore the fact that electricity is the source of electromagnetism. The fact that electric currents possess magnetic fields will be dealt with. The numerous applications of an electromagnetic field will be considered and exemplified.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 3: Unit Two
(2) Unit on Electricity - pages 93-100 (For Grades 4-6)

SESSION TWO: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

SOUND

Sound will be considered from the standpoint of its cause; its mode of travel; and methods of reception. The qualities of pitch and of amplitude will be investigated in terms of the factors responsible for each. How fast sound travels compared to the speed of light will be the subject of experimentation involving the actual measurement of the speed of sound.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 4: Unit One
(2) Unit on Sound, pages 31-34 (For grades K-3)

THIRD DAY

SESSION ONE: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

LIGHT AS ENERGY

We shall compare light with sound as a form of energy in terms of mode of travel and detection. Why both can not travel through a vacuum will be pursued. Theories regarding light and how it behaves will be reviewed. Sources of light will be investigated.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 4: Unit Two
(2) Unit on Heat and Light - pages 61-64 (For grades K-3)

SESSION TWO: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

EFFECTS UPON LIGHT

As a follow-up to our work in the first session we shall now consider what can happen to light and the circumstances under which each effect is to be noted. We shall investigate the uses to which one can put the following: reflect, absorption, refraction, polarization.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 4: Unit Two
(2) Unit on Heat and Light,
pages 61-64 (Grades K-3)

IN-SERVICE TRAINING PROGRAM
IN PHYSICS FOR GRADES
FIVE AND SIX

OBJECTIVES AND APPROACH: Edmund Spenser in "The Tears of the Muses" says:

> Through knowledge we behold the world's creation,
> How in his cradle first he fostered was:
> And judge of Nature's cunning operation,
> How things she formed of a formless mass ...

A child's curiosity concerning the things about him seems insatiable. Unlimited are the questions which he raises about things which he can see. Quite often difficult, however, are the answers which inevitably border on the abstract.

> Things which are seen were not made of
> things which do appear. Hebrews, XI-3

It will be the attempt of this In-Service Training Program to meld the concrete with the abstract; to establish relationships between things which we can see and those which we can not see.

Physics is not merely a body of subject-matter nor is it a collection of mathematical puzzles. It is a science of <u>inquiry</u>. During our sessions together we shall consider such inquiries as:

> In what ways do machines help us accomplish work?
> Of what does a simple lever consist? Does its application alter the amount of work involved?
> In what ways can a lever effect the force necessary to do work?
> The distance over which the force must be applied?
> What type of levers help us?
> In what ways does the work put into a system compare with the work accomplished? Why?
> Are the forces of friction and of gravity always against us?
> In what ways does heat energy help us to do work?
> How does a change in state of a substance such as water effect its capacity to do work?
> How does the statement "Actions have equal but opposite reactions."
> Help us to understand ways in which work may be accomplished?

Although there is but one kind of electricity, in what forms may it exist and in what ways do they differ in their sources?
How are electricity and magnetism related?
How does this relationship help us to do work?
Into what other forms of energy can electricity be converted? How?
How does electrical energy differ from atomic energy?
What sources and uses of atomic energy do we know?

During our In-Service Training Program we shall explore the concepts suggested by these questions in addition to others as appropriate. Since Physics is an experimental science we shall concern ourselves with the methods and materials designed to help us to obtain information about our physical environment. Toward this purpose we shall carry out a series of sessions in the laboratory which will be blended with periods occupied by lecture-demonstrations and discussions to afford a maximum opportunity for understanding the related concepts, for developing skills in the fabrication and subsequent utilization of various materials, and for the analysis of data obtained by their use as well as from other sources.

To the extent that the design of the In-Service Training Program, and time permit, it is the desire of the consultant to provide an opportunity for the participant to:

1. Preview the material and activities to be covered in advance of each session, enabling him to prepare himself through consulting the references provided and thus gain a better insight into their direct application in his classroom.

2. Discuss any problems arising with the activities suggested after he has tried them out. The consultant will attempt to help the participant implement the subject-matter as well as techniques within the framework of his own classroom situation.

The design of the program will be suggested by the following:

1. Concepts in Science, Brandwein, Cooper, Blackwood, Hone, for Grades Five and Six

2. Science For Children, Grades 4-6, New York State Education Department.

(References to the source materials listed above will be numbered in the same order.)

FIRST DAY

SESSION ONE: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

HEAT ENERGY

Heat as a form of energy with its capacity to do work will be dealt with. Various methods by which it travels from one place to another will be explored. The effects of heat loss and of heat gain upon the size and temperature of a substance will be considered.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 6: Unit Two and Unit Five
(2) Unit on Heat and Work, pages 51-56 (Grades 4-6)

SESSION TWO: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

MACHINES

It will be important to integrate this session with that in Astronomy which covered weight and mass concepts as a part of Unit Three in Grade 5. These underlie a basic understanding of force which is so important in the analysis of levers. We shall first review carefully the requirements for doing work, exerting a force over a distance. If either of these requirements is lacking, work is not performed.

We shall begin our work with simple levers in order to be able to analyze the forces applied to and obtained from a system.

Work against gravity and against friction will be covered.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 6: Unit Four
(2) Unit on Heat and Work - pages 51-56 (Grades 4-6)

SECOND DAY

SESSION ONE: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

MACHINES (Continued)

We shall continue our consideration of simple machines and how they effect our capacity to do work. We will note their effect upon the forces as well as the distances over which these forces are acting. We shall investigate whether the work put into a system is always equal to the work taken out.

Such simple machines as the pulley, the wheel and axle, the inclined plane, and the screw will be investigated. The concept of efficiency will be introduced.

Finally we shall review the laws of Newton including the concept of an equal but opposite reaction to a force.

(1) Grade 6: Unit Four
(2) Unit on Heat and Work - Pages 51-56 (Grades 4-6)

SESSION TWO: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

ELECTRICITY

We shall begin our study of electricity in the form known as static electricity. We shall consider electron as particles with a charge (-). We shall identify substances which readily allow the build up of these charges and compare these with others which do not permit such a build up. We shall compare this form of electricity with that known as current electricity and investigate the situations responsible for each type. We shall thus compare conductors with insulators.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 6:Unit Six
(2) Unit on Electricity - pages 93-100 (Grades 4-6)

THIRD DAY

SESSION ONE: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

ELECTRICITY (Continued)

We shall continue our study of electricity by considering its source, distribution, and finally its use in terms of possible conversion to other forms of energy. We shall thus consider its generation by moving a wire through a magnetic field; its distribution by means of various types of circuits; and finally its use as we employ electricity to furnish us with: a magnetic field, heat, or light.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 6: Unit Six
(2) Unit on Electricity - pages 93-100 (Grades 4-6)

SESSION TWO: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

ATOMIC ENERGY

We shall compare atomic energy with electrical energy in terms of its source and capacity to do work. We shall briefly discuss natural radioactivity, fission and fusion and the uses to which each of these phenonena is put.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 6: Unit Seven
(2) Unit on Matter and Energy - pages 152-161 (Grades 4-6)

IN-SERVICE TRAINING PROGRAM
IN PHYSICS FOR GRADES
SEVEN, EIGHT, NINE

OBJECTIVES AND APPROACH: Edmund Spenser in "The Tears of the Muses" says:

> Through knowledge we behold the world's creation
> How in his cradle first he fostered was;
> And judge of Nature's cunning operation,
> How things she formed of formless mass ...

A child's curiosity concerning the things about him seem insatiable. Unlimited are the questions which he raises about the things which he can see. Quite often difficult, however, are the answers which inevitably border on the abstract.

> Things which are seen were not made of things which do appear. Hebrews, XI-3

It will be the attempt of this In-Service Training Program to meld the concrete with the abstract; to establish relationships between things which we see and those which we cannot see.

Physics is not merely a body of subject-matter nor is it a collection of mathematical puzzles. It is a science of inquiry. During our sessions together we shall consider inquiries such as:

> How did Isaac Newton help us to understand "Force"?
> How did Galileo demonstrate what a force is?
> How can you describe a motion such as that of a car in terms of its speed? Velocity? Acceleration?
> How does weight differ from mass?
> How do the terms "Energy" and "Power" aid us in describing our capacity to do work?
> What do we mean by efficiency?
> On the basis of what we know about what causes sound, what characteristics of a sound aid us in its identification?
> What conditions effect the ability of sound to travel?
> Why do you see a batter hit the ball before you hear it?
> How have we been able to improve our lives by better understanding light?
> Why do people wear eyeglasses?
> In what way do we depend upon heat energy during the day?
> How is a room heated? How is the earth heated?
> In what ways does heat resemble light? Sound?
> How does it differ?

How does electricity improve our daily life?
How is it generated and distributed to us?
Into what other forms of energy is it converted in order to help us. How?
What is the use of a magnetic field?
Where does it come from?
What do we mean by atomic energy and what is its source?
How is it used?

During our In-Service Training Program we shall explore the concepts suggested by these questions in addition to others as appropriate. Since Physics is an experimental science we shall concern ourselves with the methods and materials designed to help us to obtain information about our physical environment. Toward this purpose we shall carry out a series of sessions in the laboratory which will be blended with periods occupied by lecture-demonstrations and discussions to afford a maximum opportunity for understanding the related concepts, for developing skills in the fabrication and subsequent utilization of various materials, and for the analysis of data obtained by their use as well as from other sources.

To the extent that the design of the In-Service Training Program, and time permit, it is the desire of the consultant to provide an opportunity for the participant to:

1. Preview the material and activities to be covered in advance of each session, enabling him to prepare himself through consulting the references provided and thus gain a better insight into their direct application in his classroom.

2. Discuss any problems arising with the activities suggested after he has tried them out. The consultant will attempt to help the participants implement the subject-matter as well as techniques within the framework of his own classroom.

The design of the program will be suggested by the following:

1. The World of Living Things, The World of Matter-Energy, and Exploring the Sciences, by Brandwein, Beck, Strahler, Brennan. (Grades 7,8 and 9)
2. The General Science Handbook Parts I, II, and III, and blocks I, B,L,K of Science 7,8,9, New York State Education Department.

(References to the source materials listed above will be numbered in the same order)

FIRST DAY

SESSION ONE: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

MECHANICS

We shall review comprehensively the concepts of: force, velocity, acceleration, weight, and mass as they are defined by the laws of Newton and dealt with by the experiments of Galileo. (Weight and Mass have or will be covered in the Astronomy workshop in Grades 5 and 6). The forces of gravity and of friction will be dealt with in terms of when they help and when they hinder us in our vector quantities will be developed.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 8: Unit Five; Chapter 15
Grade 9: Unit Four; Chapter 15
(2) General Science Handbook Part I - page 71-88
Science 7,8,9: Block I: Forces at Work

SESSION TWO: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

MACHINES AND HEAT

The concepts which we have of energy, work, and power will be developed upon those considered in our morning session. The efficiency of simple machines will be dealt with. We shall begin our study of heat in terms of the applications to machines of changes of state. This will be a part of our discussion of the transformation of energy from one form to another.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 8: Unit Five; Chapter 16
Grade 9: Unit Four; Chapter 16
(2) General Science Handbook, Part 3, page 77-93
Science 7,8,9: Block B; The Body at Work
Science 7,8,9: Block K; Energy at Work

SECOND DAY

SESSION ONE: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

HEAT AND SOUND

We shall complete our discussion of Heat by considering its methods of transfer. We shall compare these with those involved in sound transmission. We shall deal with the causes, transmission and reception of sound waves as a form of energy. Characteristics of sounds and how they are produced will be treated.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 8: Unit Six, Chapter 18
Grade 9: Unit Six, Chapter 20
(2) General Science Handbook: Part 2, page 108
Grades 7,8,9: Block K Energy at Work

SESSION TWO: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

LIGHT

The characteristics of light as a form of electromagnetic radiation will be dealt with as described both by the wave and quantum theories. How it is transmitted, reflected, absorbed, refracted, and scattered will be considered in terms of the substances with which it comes in contact. The uses of lenses and mirrors in astronomy and for every-day application will be taken up in terms of how these make light useful to us.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:
(1) Grade 8: Unit 6; Chapter 19
Grade 9: Unit 6; Chapter 21
(2) General Science Handbook: Part 1, page 117-124
Grades 7,8,9: Block K Energy at Work

THIRD DAY

SESSION ONE: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

ELECTRICITY AND MAGNETISM

Electricity as potential energy (static) and as Kinetic energy (current) will be discussed. The roles played by insulators and by conductors in this respect will be explored. The fact that a flow of electrons possesses a magnetic field will be treated in terms of the properties (and therefore uses) of the field as attributed to the current causing it. The importantance of ferromagnetic materials will be considered. The source, transmission and final employment of electric currents will be dealt with.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children.

They will be selected from:

(1) Grade 8: Unit Four, Chapter 13
Grade 9: Unit Five, Chapter 17
(2) General Science Handbook: Part 2, pages 45-54
General Science Handbook: Part 3, Page 48
Grades 7,8,9: Block K Energy at Work

SESSION TWO: LECTURE-DEMONSTRATION followed by LABORATORY EXERCISE on:

ELECTRICAL AND ATOMIC ENERGY

The uses of electrical energy by transforming it into other forms (magnetic, mechanical, heat, and light) will be explored. The role played in communication by electricity will be dealt with. The difference between the energy of the nucleus will be treated. They will be compared with each other in terms of their sources, magnitudes, and uses.

Activities will be of two major types: Those to be teacher directed and those to be carried out by the children. They will be selected from:

(1) Grade 8: Unit Five, Chapter 17. Unit Four, Chapter 14. Grade Nine: Unit Five, Chapter 18
(2) General Science Handbook: Part I, pages 53-71
General Science Handbook: Part 3, pages 51-77 and 125-155. Grades 7,8,9: Block K. Energy at Work
Grades 7,8,9: Block L Living with the Atom.

IN-SERVICE TRAINING PROGRAM
IN GEOLOGY FOR GRADES
ONE THROUGH NINE

OBJECTIVES AND APPROACH: Probably most geologists first became interested in the earth because of facinating or adventuresome experiences in the field as a child. Mountains, waterfalls, springs, or other equally interesting geologic phenomena can be observed everywhere. Many of our best paleontologists grew up in areas where fossils could be easily picked from the rocks. Likewise, the collection of mineral specimens and rocks is an interesting hobby of many children. These activities often continue into adulthood and to many working geologists the observation of the earth is both a hobby and a profession. However, there is another equally interesting--but more important--side to geology that we must be aware of and must certainly make our students aware of: Geology is a useful science that is responsible for two practical functions:

(1) To supply the basic raw materials, fuels, and water, upon which our society is utterly dependant, and

(2) To provide knowledge of the earth that allows us to avoid building in hazardous locations such as over active sink holes and faults.

Historically much more geological training and expertise has been applied to resource problems than to geological hazards, but, more recently, the value of geological advise in avoiding hazards has become increasingly recognized by public officials and builders. In any event, it must be realized by the teacher that most geologists are, in fact, employed by oil or mining companies. These and other commercial organizations are willing to pay for expert geological advice because by doing so they can extract materials from the earth profitably.

In the writers experience geology, as well as the other sciences, is more interesting and vital if introduced within a framework of practicality. The student should see the subject as something he can become involved in and not as a dead, entirely known subject. With this in mind the basic philosophy of this course will be to:

(1) Introduce a limited number of geologically interesting and important phenomena, and where possible to emphasize their practical aspects.

(2) To provide the teacher with an understanding of the subjects in sufficient depth to allow him to become interested and thereby to arouse the interest of -- and answer most questions of--his students.

(3) To suggest to the teacher some ways in which the subjects can be illustrated or studied in the laboratory and in the field. As part of this phase, a field trip will be conducted to the Florida Keys to study present day limestone formation and analogous but much older rocks will be examined in several mines, quarries, and outcrops in central and southern Florida. An area of active sink hole formation will also be visited to illustrate one type of geologic hazard.

FIR3T DAY

SESSION ONE: DISCUSSION AND LABORATORY OBSERVATION

Minerals will be introduced by means of a coordinated lecture-laboratory session in which the materials will be examined by the participants while being described by the lecturer. The crystal-chemical relationships that produce various physical properties will be stressed. Although mineral names will be used the principal emphasis will be placed on understanding the properties of the materials and their industrial uses.

Participants will observe rapidly crystallizing materials as part of this session. Some methods of classroom illustration of crystal growth will be discussed.

SESSION TWO: DISCUSSION AND LABORATORY OBSERVATION

Rocks appear as solid, inert materials that stoutly resist change. In human terms this concept is generally true, but in terms of the age of the earth it is misleading. Actually all rocks are part of a vast cycle in which they are formed, are gradually altered and destroyed, and whose components are used again in the formation of newer rock types.

At the surface of the earth we can observe several small parts of this grand rock cycle. For example, we can witness the gradual weathering and erosion of rocks and the movement of the weathered components into streams, deltas, and the oceans. There we can observe the collection of the components into sediments, and in some places we can observe how the sediments become bound together into sedimentary rocks. (On our field trip to the keys we will see several types of limestones actually forming.)

The other parts of the rock cycle are less easily observed and must be inferred by piecing together evidence of diverse types. Much of the evidence is still to be collected and assimilated, hopefully by some of the students whose interest you arouse in your classes.

In this session, a number of important rock types will be observed and their placement in the rock cycle will be discussed. Some of the economically important materials associated with the rock cycle stages will be introduced and the general means used by geologists to find them. The economically important minerals, rocks, and fuels of the Gulf Coast will be stressed.

SECOND DAY

SESSION ONE: LECTURE AND LABORATORY OBSERVATION

In this session we will consider what is known of the materials that compose the interior of the earth and how little of the earth can be seen directly even in the deepest oil wells and mine shafts. Earthquake phenemona will be introduced and the shock waves they produce will be described. Particular emphasis will be placed on the way earthquake waves and other such indirect methods have been used to deduce the interior structure and composition of the earth.

The theory of drifting continents and the possibly related phenomena of folded mountains and mid-ocean ridges will be discussed. Recent evidence concerning migration of the poles ("polar-wandering") and reversals in polarity of the earth's magnetic field will also be considered. These subjects are on the forefront of present day geologic research. The means of investigating them and questions awaiting further research will be noted.

SESSION TWO: LECTURE AND LABORATORY OBSERVATION

The earth is at least 4.5 billion years old. Rocks in excess of 2 billion years old have actually been dated by indisputable methods based on the radioactive decay of uranium to lead, potassium to argon, thorium to lead, and similar long-lived but unstable materials. These radiometric methods will be reviewed briefly.

The earth has developed over a time span of several billion years. Approximately 0.6 to 1.0 billion years ago the record suggests that living organisms first appeared on the earth. Since that time remains from these organism have been preserved in various ways in sedimentary rocks. By careful, diligent study of these plant and animal remains geologists have an insight into the progression of types of organisms that inhabited the earth through its long history.

From this study, combined with a study of rock ages bases on radioactive decay, the earths history has been divided into a number of time intervals known as eras, periods, epochs, and stages. The types of organisms that have been preserved in different age rocks will be described briefly and the concepts of"index fossils" (i.e. organisms that lived only during a limited time span) and "facies fossils" (i.e. organisms that could only live in a particular environment) will be discussed. The apparent changes in animal and plant groups through time will be reviewed.

THIRD DAY

SESSION ONE:

The geologic history of the Gulf Coast will be reviewed. In particular, the geologic history of the Florida Peninsula will be emphasized in order that the teachers will be better able to point out geologically interesting features of their students. Some further features of Florida geology will be described on the field trip that will follow. This trip, including travel time will occupy the remainder of the second day and all of the third and fourth day.

FIELD TRIP

SESSION TWO: OF THIRD DAY (AND ALL FOURTH DAY):

The exact stops to be visited on the field trip may have to be varied somewhat depending on the weather and on cooperative arrangements with several mining companies. Tentatively the following general itinerary is planned:

Depart Howey-in-the-Hills approximately 10:30 a.m. via chartered bus.

Proceed to the Lakeland-Bartow vicinity (Polk County) and visit the mining operation of a major phosphate producer. Florida is the principal producer of phosphate for the entire country. The mining andprocessing operation will be discussed by a geologist employed by the company. There will be an opportunity to collect vertebrate remains such as shark teeth and "manatee" ribs associated with the deposit.

Proceed to the quarry of the Belle Glade Rock Company at Belle Glade (Palm Beach County) where there is an excellent exposure of the Caloosahatchee formation (Unit A). This is one of the best locations in the Gulf Coast for the collection of well preserved mollusk fossils.

FOURTH DAY

Breakfast should be made available at a local restaurant. This day will be spent in observing the following geologic features of the Florida Keys:

(1) The actively growing coral-algal reef tract. This is the only active reef of its type in the United States and has been visited by geologists from all over the world in order to study the processes of limestone formation. It will be visited by means of five boats. The boats will anchor on the reef and allow time for the participants to view the reef either by swimming with face masks or through glass bottom boats or viewers. The water is less than ten feet deep. Participants should wear tennis-type shoes to avoid cutting their feet on the coral. Some collection for classroom use will probably be possible (but not from the waters of Pennecamp State Park, an underwater preserve).

Box lunches should be provided.

(2) Florida Bay, in which fine-grained "lime mud" is accumulating. This area is quite different from the reef tract and the limestone type is obviously quite different. Collections can be made from a small oceanographic grab sampler (that will be provided) or directly from a mudbank.

(3) The slightly older limestones of the Florida Keys will be observed in a quarry on Windley Key and in a canal wall on Key Largo (if time permits). Collections can be made from the quarry and canal walls, where numerous large coral heads and other features can be seen.

Following the above the party will return directly to Howey-in-the-Hills. Approximate time of return 10:00 P.M. It is suggested that a dinner stop be made enroute.

Enclosed herewith is the itinerary for field trip.

FIELD TRIP REQUIREMENTS

BUS: 770 miles (approximately)

MEALS:

Dinners:	2 stops enroute
Lunch:	1 box lunch
Breakfast:	1 near motel where overnight stop is made

BOATS: for 30 people approximately 8:30 A.M. to 3:00 P.M.

MOTEL: for 30 people, probably most as doubles.

MISC:

Sample bags (plastic) and labels
Sealer for bags (1)
Rock hammers (10)
Grab sampler (1)
Field Trip Guidebook (120 +)
Face masks (8)
Glass-bottom-viewers (8)
Sunburn lotion

FIRST DAY:

Leave Howey	10:30 A. M.
Arrive Lakeland IMC	11:45 A.M.
Leave Lakeland IMC	12:45 P.M.
Arrive Belle Glade	3:15 P.M.
Leave Belle Glade	4:15 P.M.
Arrive Islamarada	6:30 P.M.
Dinner at Chesapeake House	7:30 P.M.
Arrive Motel	8:30 P.M.

SECOND DAY:

Breakfast - To be arranged	7:30 A.M.
Board Bus - Coral Reef State Park	8:30 A.M.
Arrive at dock and board boats	9:00 A.M.
Leave docks	9:00 A.M.
Proceed to reefs	
Leave reefs	11:30 A.M.
Arrive Key Largo Canal	12:00 Noon
Leave Key Largo Canal	12:30 P.M.
Arrive Florida Bay	1:15 P.M.
Leave Florida Bay	2:15 P.M.
Arrive Swash Key	2:45 P.M.
Leave Swash Key	3:15 P.M.
Arrive Dock	4:00 P.M.
Board bus	4:00 P.M.
Dinner at Homestead	5:00 P.M.
Arrive Howey-in-the-Hills	10:00 P.M.

TENTATIVE SCHEDULE

IN-SERVICE TRAINING COURSE IN

GEOLOGY

FIRST DAY

SESSION ONE:
Minerals and crystal growth.

SESSION TWO:
The rock cycle: sedimentary, metamorphic, and igneous rocks and their inter-relationships

SECOND DAY

SESSION ONE:
Interior of the earth, earthquakes, continental drift, mid-ocean ridges, "polar-wandering", and magnetic field reversals.

SESSION TWO:

Radiometric methods and the age of the earth.
Fossil remains
Geologic time scale

THIRD DAY

SESSION ONE:
Geologic history of the Gulf Coast, especially Florida

SESSION TWO:
Leave for field trip (10:30)
Phosphate mine (Lakeland)
Proceed to Islamorada (arrive 8:30 P.M.)

FOURTH DAY

SESSION ONE: (morning)
Boat trip to reef tract

SESSION TWO: (early afternoon)
Boat trip to Florida Bay.

SESSION THREE:
Quarry on Windley Key and/or Key Largo Canal.

RETURN TO HOWEY-IN-THE-HILLS: (leave approximately 4:00 P.M.)

ARRIVE HOWEY-IN-THE-HILLS about 10:00 P.M.

END-OF-COURSE

ADDENDUM

NASA EDUCATIONAL PROGRAM

TRI-COUNTY SPACE WORKSHOP

FOR ELEMENTARY TEACHERS

AUGUST 28-29-30, 1968

In addition to the two-weeks In-Service Training Program in astronomy, physics and Florida geology, the supervisory and Science Center staff met with consultants from NASA and developed a three-day space workshop for forty elementary teachers in the tri-county area. The workshop is scheduled for August 28, 29, and 30, 1968. Robert E. Wilson and Kenneth H. Watkins will serve as consultants to the workshop.

Below is the program outline:

WEDNESDAY, AUGUST 28, 1968

8:30 A. M. - 9:30 A. M.	"Man Explores Air and Space"
	Robert E. Wilson
9:30 A. M. - 10:30 A. M.	"Power For Space Flight - Newtonian Laws"
	Kenneth H. Watkins
10:30 A. M. - 12:00 Noon	Power Space Flight Activities
	Robert E. Wilson Kenneth H. Watkins
12:00 Noon - 1:00 P. M.	Lunch
1:00 P. M. - 2:00 P. M.	"What Keeps a Satellite in Space"
	Kenneth H. Watkins
2:00 P. M. - 3:30 P. M.	"Orbits and Trajectories Activities"
	Robert E. Wilson Kenneth H. Watkins

THURSDAY, AUGUST 29, 1968

8:30 A. M. - 9:30 A. M.	"How We Get Information To and From Satellites" Kenneth H. Watkins
9:30 A. M. - 11:00 A. M.	Communications and Telemetry Activities Robert E. Wilson Kenneth H. Watkins
11:00 A. M. - 12:00 Noon	"Satellites for Peaceful Use Robert E. Wilson
12:00 Noon - 1:00 P. M.	Lunch
1:00 P. M. - 2:30 P. M.	Satellites for Peaceful Use Activities Robert E. Wilson Kenneth H. Watkins
2:30 P. M. - 3:30 P. M.	"Spacecraft System" Kenneth H. Watkins

Assignment for Evening:

List the types of information gathered from various experiments made on-board spacecraft:

FRIDAY, AUGUST 30, 1968

8:30 A. M. - 9:30 A. M.	"Requirements for Life Beyond Earth"	Robert E. Wilson
9:30 A. M. - 11:30 A. M.	Exobiology Activities	Robert E. Wilson Kenneth H. Watkins
11:30 A. M. - 12:00 Noon	"Human Factors"	Robert E. Wilson
12:00 Noon - 1:00 P. M.	Lunch	
1:00 P. M. - 2:30 P. M.	Human Factors Activities	Robert E. Wilson Kenneth H. Watkins
2:30 P. M. - 3:30 P. M.	Wrap-up Seminar (Previous Evening's Assignment to be discussed briefly, also)	Robert E. Wilson Kenneth H. Watkins